JARVIS ENGINEERING COMPANY, BOSTON

ESTABLISHED. 1876

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JARVIS ENGINEERING COMPANY

ENGINEERS AND MASONS

61 OLIVER STREET
BOSTON, MASS.

Established, 1876

1 9 0 4

The modern majesty consists in work.

What a man can do is his greatest ornament, and he always consults his dignity by doing it.

— *Carlyle.*

IN presenting our catalogue to steam users we wish to emphasize the fact that too great care cannot be exercised in laying out the Steam Plant, in order that the same may be safe, durable, and capable of being run at the minimum of cost. This, we think, in view of our extensive experience, we are particularly qualified to do, having during the last twenty-eight years installed steam plants in nearly all parts of the country.

When the manufacturer is confronted by the condition where it is necessary to put in new boilers or engines, he quickly realizes that his position is one of grave responsibility, involving usually a considerable expenditure of money. It is, therefore, of paramount importance that he makes a wise selection, not only in the apparatus to be used but also in the people who are to perform the work. In all probability he will not only save money, but much useless anxiety if he will place his job in the hands of some firm or individual who is known to have an extensive experience and an undoubted reputation for fair dealing.

Perhaps the introduction of electricity for lighting and motive power purposes, more than any other one thing, has brought about the high state of efficiency of the modern steam plant, and it is generally well known that we are promised great developments in the near future by the use of high-pressure superheated steam in connection with the turbine engine, all of which may be realized; but we are convinced that the average steam user will be consulting his own interests by continuing the use of a high-class reciprocating engine, with efficient boilers carrying medium pressures, with furnaces and grate bars adapted to burn the cheaper grades of fuel.

During the many years of our business life our constant care has been to make the interests of our customers our first object, believing that to leave a customer well satisfied was the easiest way to procure another. We are prepared to consult owners with a view of preparing plans for the installation of Boilers, Engines, and Complete Steam Plants.

Ball and Wood Engines.

Cylinders are made of an iron hard and close grained, and radiation is prevented by a thick jacket of asbestos cement, outside of which is fitted a neat and simple casing of iron.

Cylinder heads are made from carefully selected castings, free from sand and blow holes.

Pistons are cast from patterns having due regard to strength and lightness. They are turned with grooves into which are accurately fitted cast-iron rings sprung into place.

Piston-rods are made of the best cast steel of ample diameter. They are secured to the piston by taper heads and nuts.

Steam chests are cast in one with the cylinders. The valve seats are carefully finished and the ports squared and trimmed to a smooth and accurate edge.

The valve is made in two parts, having its faces opposite and parallel. Telescopic sleeves connecting these two parts maintain each face against its corresponding seat in the steam chest. Steam is admitted to the interior of the valve and thence through the ports into the cylinder. Its faces being flat wear smoother the longer the engine is in service. The pressure of steam keeps the valves and seats in good contact without excessive friction.

Main bearings are fitted with removable Babbitt shells which can be easily and cheaply replaced when necessary.

The guides in Center Crank types of engines are of the locomotive pattern and are interchangeable. In the Side Crank types they are bored. They are carefully scraped to

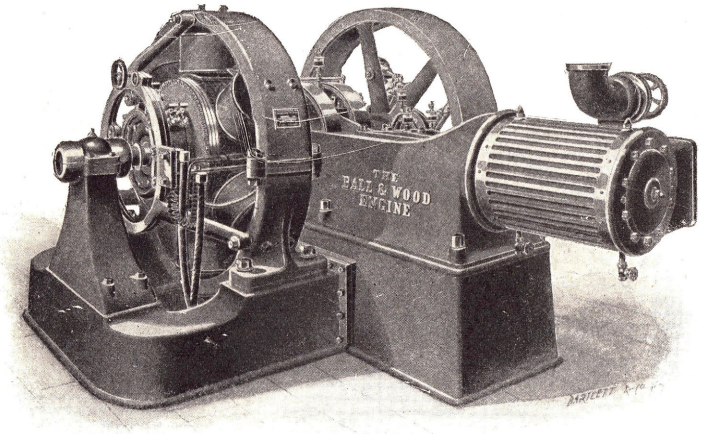
surface plates and provision made for taking up wear. The crosshead has ample wearing surfaces also scraped and is fitted with a pin of hardened steel.

Connecting rods are of the best forged steel and fitted with Babbitted boxes which can be taken up as fast as wear occurs.

Counterbalanced shafts are made large in diameter and of either forged or cast steel. Every shaft is carefully counterbalanced, and before shipment each engine is placed in careful running balance.

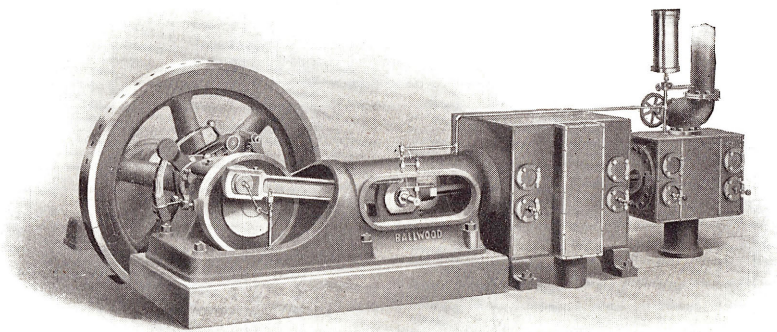
The governor is of the inertia type and has a swinging eccentric, the eccentric center moving across the end of the shaft about an outside point and giving a lead which varies with the point of cut-off from a maximum at the latest point to zero, when the governor weights occupy their extreme outward position. Any alteration in speed is easily obtained by changing the amount of weight in the pockets of the lever arm.

Direct Connected Engines.



The advantage of dispensing with pulleys and belts making the dynamo and engine practically one machine has led to the development of the direct connected unit, and we are prepared to connect our engines, either horizontal or vertical, to any of the standard makes of dynamos, being well equipped with patterns for this service and having a large portion of our business already lying in that direction.

Corliss Valve Engine.



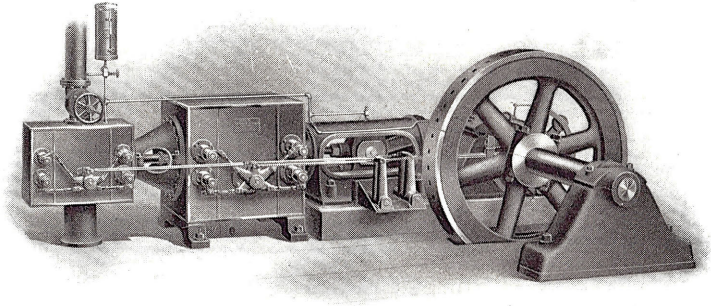
The crank shaft is of the best quality of forged steel of high carbon, large in diameter. The bearings and crank pins are of unusual size and the latter are provided with automatic, centrifugal oiling devices, giving ample means of lubrication.

The main bearing pillow blocks for carrying the shaft are carefully bored and are provided with removable Babbitt liners which are interchangeable. The liners are carefully fitted and scraped to their seats and the shaft journal, and can be readily replaced by lifting the shaft less than one-quarter inch. At the outer end of each pillow block a special oil catching ring is provided to prevent the oil from following out on the shaft and getting into the armature or wheel.

The connecting rods are of forged machinery steel of low carbon, and are provided with heavy straps and boxes with ready means of adjustment at both ends.

The crank pin boxes are of cast iron, lined with Babbitt metal or of phosphor-bronze depending upon the general design of the engine

The crosshead boxes are made of the best quality of phosphor-bronze.



The crossheads are of ample strength throughout, giving large wearing surfaces which are faced with genuine Babbitt metal.

The cylinders, being plain castings flanged at the ends, lend themselves admirably on account of the simplicity in design, to the obtaining of castings better suited to the purpose. They are neatly lagged with sheet steel, enclosing a thick layer of non-conducting material.

The piston rods are made of special hammered crucible steel. They are threaded and screwed into the crosshead and locked fast with a special nut. The other ends of the rods are fitted to the piston with a taper and shoulder and locked with a nut.

The pistons are of the box section of cast iron, as light as consistent with the load upon them. They are provided with suitable piston rings so designed as to give a uniform bearing pressure against the cylinder walls, making the piston a steam tight fit in the cylinders.

The admission valves are of the Corliss pattern, actuated from a separate wrist plate for each cylinder, which are both controlled by the inertia governor placed in the fly-wheel of the engine.

The exhaust valves are of the Corliss pattern, driven from a separate wrist plate for each cylinder, which is in turn actuated by a fixed eccentric, so that each may be adjusted quite independently of the other and also of the admission valves, giving a release and compression which does not vary with the cut-off.

All the valves are located in the heads of the cylinders, thus reducing the length of the ports and the clearance volume to the least possible amount. These valves being unbalanced take up their own wear automatically, remaining steam tight and retaining their initial efficiency indefinitely, so that the replacing or truing up of valves or seats is never necessary. The admission valves are backed off to permit lifting from their seats for any excessive pressure in the cylinder, and we find that no additional reliefs are necessary under ordinary circumstances.

The governor is of our latest design, in which the eccentric is a part of an inertia mass distributed in the wheel so as to be extremely sensitive to the slightest change of speed. This mass is pivoted on trunions which are carried in bearings on the shaft of the engine provided with an arrangement for taking up wear. This construction dispenses entirely

with all overhang, and the thrust of the valves is received between the two bearings. The centrifugal force for determining the speed of the engine is developed by a weight, pivoted so as to be acted upon strongly by its tangential inertia, and is, therefore, extremely sensitive to the slightest change of speed, and, at the same time, very stable in its action.

The valve gear is of a very simple and compact arrangement, having a positive connection between the wrist plate and valve stem rock arm, but the layout of the wrist plate and connections is such that a steam distribution is obtained in the cylinders which is practically equal to that obtained by the usual slow speed Corliss Engine with releasing gear. All bearings are of ample proportions, so that the wear is infinitesimal, and where necessary we provide means for adjustment.

The receiver is in the form of a large pipe supported underneath the gallery at the back (in the Vertical type) and can be provided with a reheater where the service is such as to require it. The arrangement of receiver and connection to cylinders is very flexible and gives ready access to all the joints.

With each engine will be furnished throttle-valve, lubricator, complete oiling device, all necessary wrenches, foundation bolts, nuts and plates, and template.

W R I T E F O R C A T A L O G U E .

Hints on Using Indicator.

Don't try to balance a double acting engine or to weigh its load with one indicator. Even an indicator cannot be in two places at one time.

Don't be too lavish in the use of leading pulleys. A little ingenuity will enable one in almost every instance to so arrange a reducing motion that the cords may be led directly to the indicator and all the bother of pulleys and their supports, and, what is of greater importance, the inaccuracy due the stretch of the cord, avoided.

Annealed iron wire is better than any cord which has ever been made for connecting the indicator with the reducing motion, and the price of one hank of cord will buy a supply for years of active practise.

Don't have a long and heavy pencil lead to vibrate upon the end of your pencil lever. Break off all except what is necessary to draw the card, and file that to a fine but smooth point.

Take the atmospheric line directly after the card is taken and before the spring has time to cool. There is quite a difference in the position of atmospheric lines when the spring is cold and when it is hot.

When making a test or adjusting an engine, it pays to keep an accurate record of each step which is made and every controlling circumstance. The value of a test does not alone consist in the determination of the result sought for. A test made to determine one thing often furnishes the data for other matters. It is of value in many ways for refer-

ence, and the more valuable the more complete the data which accompany it. When making changes in the adjustment of an engine always keep a pair of cards showing the engine "as found," and take a pair after each alteration, recording upon them the changes which have been made, so that any step may be retraced and the whole record reviewed.

Do not depend altogether upon the indicator in setting an engine, but use a little common sense with it. See where your valves and connections are before you start. An engine can make a good looking card when it is in a condition unfit to run.

The functions of the steam engine indicator are to show by its diagrams the pressure of steam at every part of the stroke, the amount of lap and lead of the valve, the point of cut-off, average pressure, back pressure, point of exhaust opening, point of exhaust closure, and amount of cushion, and it enables the happy possessor to calculate the power of his engine, the amount of work it is doing at the time the diagrams are taken, the frictional load, and the theoretical rate of steam consumption.

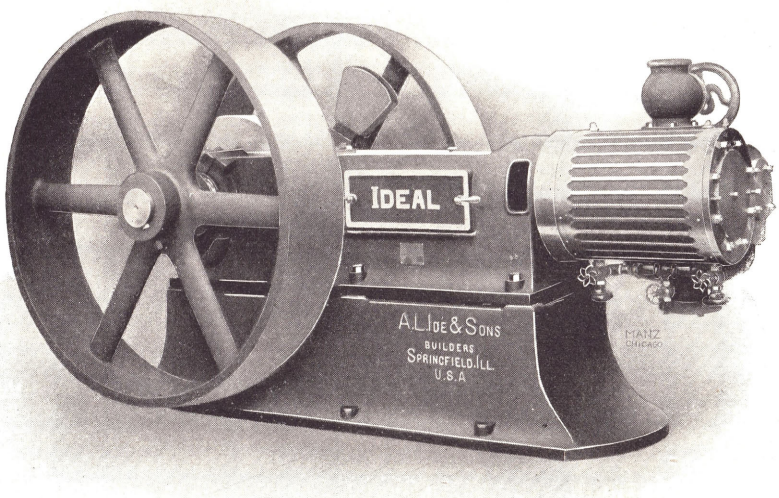
The Ideal Steam Engine and a Bit of Its History.

Albert L. Ide, the founder of the present establishment of A. L. Ide & Sons, was the originator and designer of the first horizontal self-oiling engine, and he happily named the child of his creation Ideal, using the letters of his name, A. L. Ide.

This was in the years 1887–8. The first engines of this design received instant recognition as a distinct advance in engine building, and opened the way for the steady growth of the Ideal Engine in public favor, which it has since enjoyed. From a small, almost unknown manufactory, they have grown to an establishment employing hundreds of hands, operating its own foundry, machine shop, and all departments complete; equipped with modern tools and appliances, and covering a block and a half of ground in the central part of the city of Springfield. Shipments of Ideal Engines encircle the globe, the firm being represented in all parts of the American Continent, South America, Japan, China, India, Europe, and the British possessions.

The name Ideal is a guarantee of quality and fine finish, smooth, quiet, and economical operation. The Ideal Engine is dependable.

SEND FOR LARGE CATALOGUE.


IDEAL
A.L. IDE & SONS
BUILDERS
SPRINGFIELD, ILL.
U.S.A
MANZ
CHICAGO

Standard Ideal Engines.

The accompanying view shows this engine as it appears with the standard equipment, adapted to drive any kind of machinery by belt transmission from one or both pulleys.

Simplicity is a central idea in the design, and the examination of an Ideal Engine enforces the conviction that this idea has been wrought successfully into form, giving an engine which is matchless in simple, direct, and substantial construction.

These are the elements needed in an engine built for business.

Among the many features which give distinction to the Ideal Engine, accessibility to all working parts and the ease of making adjustments deserve mention.

All working parts are easy to reach. A removable door in each side of the frame allows complete access to the cross-head, wrist-pin, and all adjacent parts.

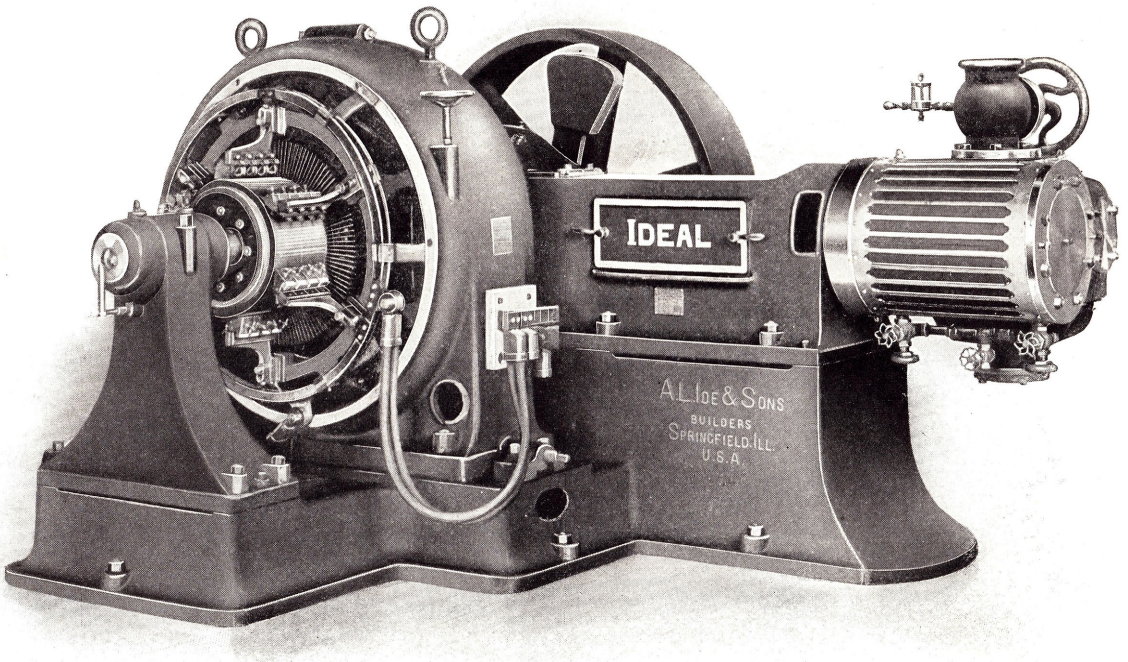
The hinged hood over the crank discs is light to lift, supports itself when raised, and gives complete access to the crank-pin and boxes.

It may be fairly claimed that for convenience in reaching all working parts, the Ideal Engine is not equaled by either the open type of engine or any of the imitations in self-oiling engines.

The piston-rod stuffing-box is enclosed in a chamber by itself, having hand openings at either side. The gland may be adjusted while the engine is running, without fear of injury from the reciprocating parts through careless handling of wrenches.

There is not a single oil cup to require attention. The eccentric is oiled from a self-filling cup attached to the hood, and provided with dropping attachment.

SEND FOR LARGE CIRCULARS. ESTIMATES CHEERFULLY FURNISHED.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SPRINGFIELD, ILL.
U.S.A.

Direct Connected Engines.

The Ideal Engine is superbly fitted for direct connected service, on account of its cleanliness, close regulation, and smooth running qualities, which permit the generator to be driven without shock or vibration.

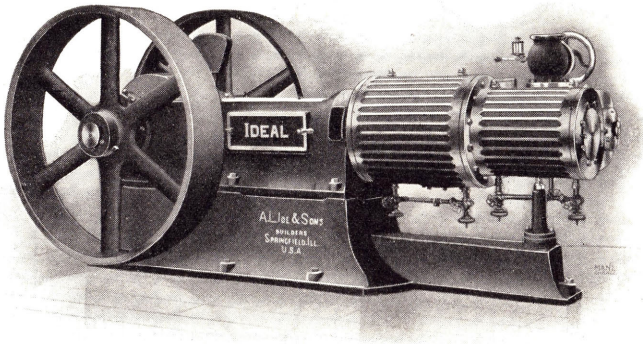
The application of the true mechanical principle of the most direct attachment of all reciprocating parts has divested the engine, as a whole, of all complications, and in consequence of the small number of details the wear has been reduced to a minimum.

Power applied directly simplifies the generating plant, reduces friction, gives greater reliability, and places more power into a given space, lessening the investment for ground, buildings, foundations, etc. Why not dispense with jack shafts, belts, etc., with their noise, expense, and cost of maintenance, and adopt the modern and advanced practise?

Being first among engine builders to introduce the direct connected type, and having filled orders for engines to receive generators from 15 kilowatts upwards, of all the leading manufacturers, we have a large variety of patterns on hand. Making all patterns, castings, forgings, and parts at our own works, with exceptional facilities, and giving to the business our undivided personal attention, promptness and certainty in executing orders intrusted to us are assured.

We point with pride to the symmetrical and substantial construction of extension to sub-base for supporting generator, which is made integral with engine base, and not separately bolted on, unless made necessary because of limitations of opening to engine room.

SEND FOR LARGE CIRCULARS OF OUR SIMPLE AND COMPOUND ENGINES.



ADDITIONAL

INFORMATION UPON

INQUIRY.

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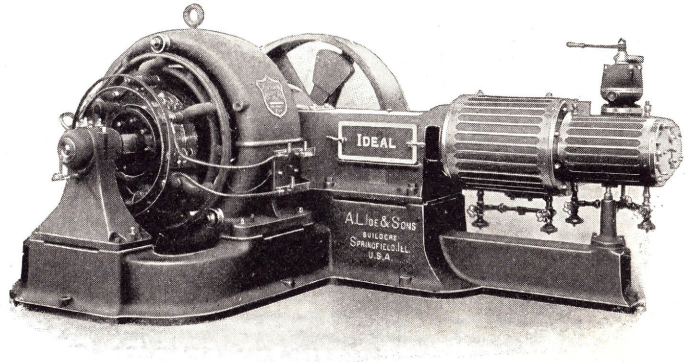


Some Practical Questions and Answers.

Q. If you were called on to take charge of a plant, what would be your first duty?

A. Ascertain the exact condition of the boiler and all its attachments, including safety-valve, steam-gauge, pump, and injector, and the condition of the engine.

Q. How often would you blow off and clean your boilers if you had ordinary water to use?

A. Once a month.

Q. What steam pressure will be allowed on a horizontal tubular boiler having a shell 60-inch diameter, 3/8-inch thick, 60,000 lbs. tensile strength, the factor of safety being 6?

A. One-sixth of the tensile strength of the plate multiplied by the thickness of plate, divided by one-half of the diameter of shell, gives the safe working pressure. In this example, $60{,}000 \div 6 \times 3/8 \div 30 = 125$ lbs.

Q. Which is the best, single or double riveting?

A. Double riveting is from sixteen to twenty per cent. stronger than single. Triple riveting, with butt joints, is much stronger than either.

Q How much heating surface is allowed per rated horse-power by builders of horizontal return tubular boilers?

A. Twelve to fifteen square feet.

Q. How much grate surface do boiler makers allow per horse-power?

A. One-fifth to one-third of a square foot.

Q. Of what use is a mud drum on a boiler?

A. For collecting and discharging the sediment in the water.

Q. How often should it be blown out?

A. Three or four times a day, depending on the character of the water.

Boiler Setting.

There has been much time and money spent in perfecting furnaces and other devices for the economizing of fuel and prevention of smoke, and while a mechanical stoker is particularly suited to the burning of small coals or mine refuse, such as screenings or other unmerchantable coal, and the prevention of smoke by its use is largely brought about by a uniform delivery of fuel to the grates, maintaining a high temperature at all times in the furnace and combustion chamber. This constant fuel supply, especially in the case of fine coal, permits the gradual distillation of the gases from the coal as it enters the furnace, and the automatic movement of the grates keeps the air spaces open, insuring the combustion of the oxygen of the air with the hydrocarbon gases in the furnace, and the complete utilization of the latter in heat making.

As the initial cost of a first-class mechanical stoker is considered prohibitive by many steam users, we will proceed to place a few facts before the reader in connection with our method of setting steam-boilers whereby eighty to ninety per cent. of the smoke can be prevented, a cheaper grade of fuel successfully burned, considerable saving effected, and this at a cost that but slightly exceeds the common setting. The process for the complete combustion and economy of fuel, using cheaper coal, and by thoroughly burning it, getting its full value, will make an effective saving to steam users. The manner in which these economies can be brought about, we have endeavored to make clear in the following description: —

For the complete combustion of fuel a fixed proportion of air is necessary. When the combustion is complete we have attained certain gases, having a definite volume, an average specific heat, and a fixed temperature, which is the maximum temperature which that fuel is capable of imparting. If air is deficient, then the fuel will be imperfectly burned and yield much less heat, giving off half-burned or wholly unburned gases. If the reader will fix these principles in his mind, we will proceed with him to examine the following facts, and observe the fireman as he charges his furnaces. He opens the fire doors quickly, and spreads as evenly as he can one or two inches of fuel over the fire. We will assume that the fuel used is fine bituminous, or bituminous mixed with anthracite screenings, and we will readily understand that this application of fuel must greatly retard the flow of air through the fire, and this at a time when an excess of air rather than a diminished quantity is required. To observe the volumes of black smoke (unconsumed fuel ascending from the stack) immediately after firing will prove conclusively that there is an insufficient amount of air to intermix with the gases liberated from the fresh fuel.

Our system of boiler setting is arranged in such a manner that all gases generated in the furnace are made to converge on the bridge wall, where they come in contact with heated air, promoting a more intense degree of combustion and smoke prevention.

Q. What is the object of a safety-valve?

A. To relieve over-pressure.

Q. What is your duty with reference to it?

A. To raise it twice a day, and see that it is in good order.

Q. What effect has cold water on hot boiler plates?

A. It will tend to fracture them.

Q. Where should the gauge-cocks be located?

A. The lowest gauge-cock ought to be placed about an inch and a half above the top row of tubes.

Q. How would you have your check-valve arranged?

A. With a valve between the check and boiler.

Q. Give the reasons why pumps sometimes fail to work.

A. Leakage of suction-pipe or plunger, and disorder of valves.

Q. How often ought boilers to be thoroughly inspected?

A. Twice a year.

Q. How would you test them for weakness?

A. With a hammer and with hydrostatic test, using warm water.

Q. If the water in the boiler is suffered to get low, what may be the result?

A. Burning of the tubes, and, when internally fired, burning of the crown sheet.

Q. If the water is allowed to get too high, what is the result?

A. It causes priming, and perhaps breaking of cylinder heads.

Q. What is the principal cause of foaming in boilers?

A. Impure water.

Q. How can foaming be stopped?

A. Close the throttle long enough to show the true level of the water. If the level is too high, blowing off will usually correct the evil.

Q. What would you do if you should find your water gone from sight very suddenly?

A. Draw the fires, and cool the boiler off as quickly as possible.

Specialties.

While we have endeavored to place our claims in a business way modestly before you, you will pardon what may appear like exaggeration when we speak of our "Steam Specialties," by which we mean our Furnace Grate-Bars, Feed-Water Heaters, Injectors, Ejectors, Syphons, Valves, etc. It is our candid opinion that the market furnishes nothing superior, and while we cannot claim more than this, we sincerely believe we ought to claim just this much. They are guaranteed in every particular, and will be sold at low prices when the quality of the goods are considered. A description of these goods will be found under their different headings, and additional information will be cheerfully furnished upon application.

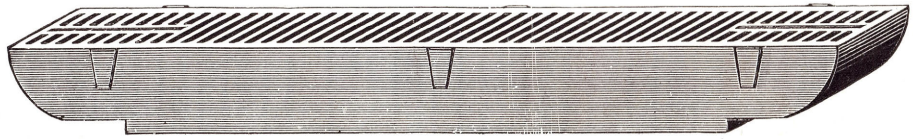
The question of what kind of grates to use is one that often perplexes the engineer. Whether to use a shaking grate, rocking, or stationary grates, ought to be determined by conditions governing the running of the plant, and the kind of fuel to be used.

We have at the foundries patterns for upwards of forty sets of grates, and are prepared to furnish either shaking, rocking, or stationary grates at a few days' notice.

Our time is at the disposal of our customers, and we would be pleased to describe our grates more fully upon written or personal application.

The Sheffield Grate Bar.

Grate-bars have not received the consideration from engineers and steam users which their importance in an economical point of view so eminently deserves. To obtain perfect combustion of fuel under a boiler requires a proper quantity of air. The quantity of air admitted depends on the size of the openings through which it passes. The old style of grate-bar generally had but twenty-five per cent. of air space when at least fifty per cent.



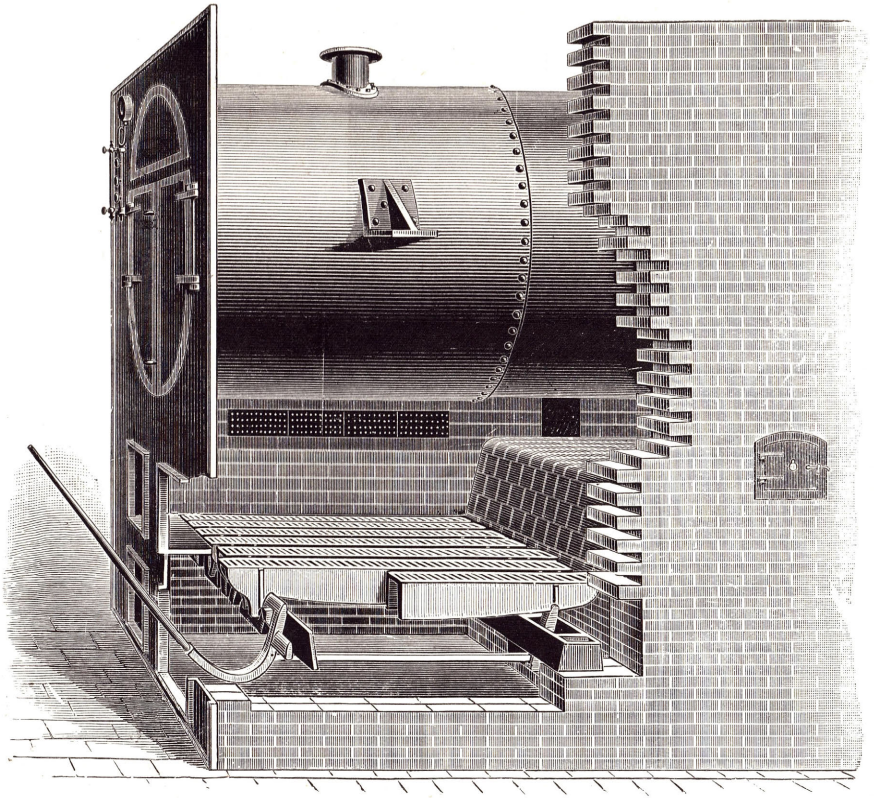
is needed. The grate-bar offering the least obstruction to the air passing through it, combined with an equal distribution of the same, must be the best adapted for the purpose of combustion. The failure of a grate-bar is due mainly to two causes — warping and burning off at the ends. To prevent the bar from burning off at the end, it should have openings for air at the end the same as in any other part of the bar, and an open bearing bar should be used instead of a solid plate, and should be set back from end of bars, so as to allow the end of the grate-bar to admit air freely.

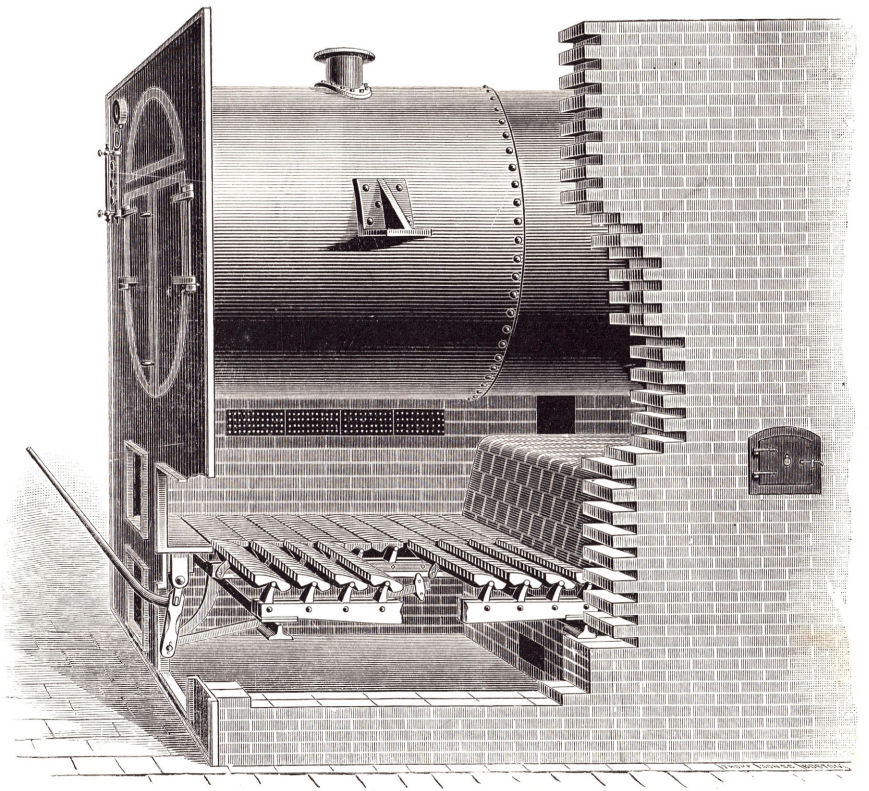
The Sheffield Grate Bar fulfils all these requirements. It has $\frac{3}{8}$ or $\frac{1}{2}$ inch openings, and *fifty per cent. air space*, the bearing bars are set back six inches from the end, and the air openings are equally distributed over its entire surface. *This bar is being used extensively for all kinds of fuel, with complete success.*

We make these bars with $\frac{1}{4}$, $\frac{3}{8}$, $\frac{1}{2}$, $\frac{5}{8}$, and $\frac{3}{4}$ inch openings as preferred, and in 4, 5, $5\frac{1}{2}$ and 6 foot lengths; also 30, 36, and 42 inch. Each bar is made six inches wide, so that we can cover any desired width of grate surface.

We also have a full set of patterns for BEARING BARS for the Sheffield Grate, for boilers of any diameter, and set one, two, or three, or more in one furnace.

The Sheffield Grate has now been in use for many years under severe and continuous duty. It has fully demonstrated its superiority over other grates in the points of durability and economy of fuel.





Q. How much water would you blow off at one time while running?

A. Never more than one gauge of water.

Q. What is the usual cause of boiler explosions?

A. Ignorance and neglect are the most usual causes of boiler explosions.

Q. Where is the proper water-level in horizontal tubular boilers?

A. A safe water-level is about two and a half inches over the top row of tubes.

Q. What is a fireman's first duty on entering the boiler room?

A. To ascertain the true water-level.

Q. When should a boiler be blown out?

A. After it is cooled off, never while hot.

Q. When laying up a boiler, what should be done?

A. Clean thoroughly inside and outside; removing all oxidation, and paint the places with red lead; and examine all stays and braces to see if any are loose or badly corroded.

Q. At what point should the feed-water enter?

A. Just below the water-level, where the cold water cannot strike the hot shell plates.

Q. How do you keep boilers clean or remove scale therefrom?

A. The best "scale solvent" is, in most cases, an honest, intelligent engineer who will regularly open up his boilers and clean them thoroughly.

Q. If you found a thin shell plate, what would you do?

A. Put a patch on it.

Q. Would you put it on the inside or outside?

A. On the inside, because the action that has weakened the plate will then act on the patch, and when this is worn it can be replaced.

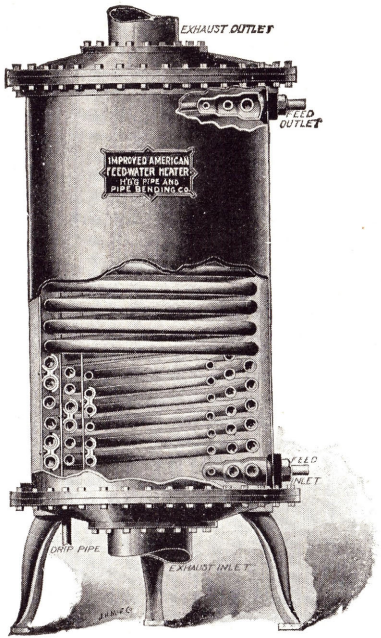
Q. If you found a blistered plate?

A. Put a patch on the fire side.

Q. What is done with a cracked plate?

A. Drill a hole at each end of the crack, caulk the crack and put a patch over it.

The Harrisburg Feed-Water Heater



Contains no joints inside of shell to leak.

Made of pure, seamless copper coils, brazed solidly to special gun-metal fittings, and supported with our improved clamp stays. All expansion and contraction is taken care of.

No back pressure on engine, nor oil in boiler possible.

Will heat feed-water instantaneously to 206 degrees to 212 degrees Fahrenheit.

All coils tested to 600 pounds pressure. Cannot be burst by feed pump.

All water in contact only with copper tubing. Nothing to rust out.

No trouble from pumping hot water.

Guaranteed in every particular.

The most durable, effective, and economical heater produced.

Save money by installing one.

S T R I C T L Y H I G H G R A D E .

The Harrisburg Feed-Water Heater.

Instructions for Setting Up. First, set legs in ring support, and place where heater is to stand, then lift heater gently upon the support, keeping the head down, which has the pipe hold for drip in. The heater is then ready to take your measurements for piping up. Always pipe up drip in lower head, so as to insure perfect drainage from the heater. If a thermometer is used, place it on outlet feed to boiler, as close to heater as possible. This can be done by putting a tee in feed-pipe close to heater.

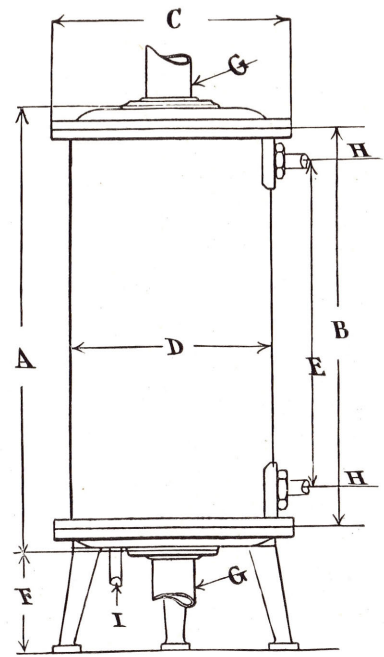
Instructions When Running. To get the best results from heater, feed boiler constantly, maintaining a given water level as near as possible in boiler.

When soda, ash, or any other solvent is used to clean boiler, pump or inject the same through heater, which will keep heater clean, and cannot possibly do any harm, as there are no places in which the solvent can lodge when passing through the heater.

Always Keep Drip from Heater Open.

NOTE. — Heaters commencing with No. 1 and ending with No. 8 Heater have no legs, and are piped up with and supported by the exhaust pipe.

Heaters commencing with No. 10 and ending with No. 500 have legs to support them.



HARRISBURG PIPE AND PIPE BENDING CO., HARRISBURG, PA.

The Harrisburg Feed-Water Heater — Dimensions.

Number.	HORSE-POWER.	Length Over All.	Length of Shell.	Diam. of Flange.	Diam. of Shell.	C to C of Feeds.	Length of Legs.	Size of Exhaust.	Size of Feed.	Size of Drip.	First Coil.	Second Coil.	Third Coil.	Material in Shell.	Weight.
		A	B	C	D	E	F	G	H	I	J	K	L		
1	**5**	13	10	9	7	8	.....	1½	½	½	¾	.....	.....	CAST IRON	44
2	**10**	17	14	9	7	12	.....	2	½	½	¾	.....	.....		50
3	**15**	17	14	12	9	11	.....	2½	¾	½	1	.....	.....		85
4	**20**	21	18	12	9	14	.....	2½	¾	½	1	.....	.....		95
5	**25**	25	19	18	15	16	.....	3	1	¾	1¼	.....	.....		235
6	**30**	26	20	18	15	20	.....	3½	1	¾	1¼	.....	.....		275
8	**40**	31	25	18	15	22	.....	4	1	¾	1¼	.....	.....		390
10	**50**	34	27	20	17	20	12	4	1¼	1	1½	.....	.....		450
12	**60**	41	34	20	17	29	12	4	1¼	1	1½	.....	.....		500
16	**80**	46	39	20	17	34	12	5	1¼	1	1½	.....	.....		545
20	**100**	52	45	20	17	40	12	5	1¼	1	1½	.....	.....		640
25	**125**	47	40	24	20	35	12	6	1½	1¼	2	.....	.....		800
30	**150**	52	45	24	20	40	12	6	1½	1¼	2	.....	.....		900
40	**200**	51	44	27	23	35	15	8	2	1¼	1½	1½	.....		1,250
50	**250**	57	50	27	23	40	15	8	2	1½	1½	1½	.....		1,460
60	**300**	62	55	27	23	45	15	10	2	1½	1½	1½	.....		1,600
80	**400**	63	55	34	28	46	15	10	2½	2	1½	1½	1½		1,800
100	**500**	69	61	34	28	52	15	10	2½	2	1½	1½	1½		1,900
120	**600**	77	67	38	32	57	15	12	3	2½	2	2	2		2,400
160	**800**	84	74	38	32	63	15	12	3	2½	2	2	2		2,850
200	**1,000**	82	71	48	42	59	15	16	4	2½	Four Coils of 2 in.			STEEL	4,000
250	**1,250**	93	82	48	42	70	15	16	4	2½	,,	,,	2 ,,		4,600
300	**1,500**	108	97	48	42	85	15	18	4	2½	,,	,,	2 ,,		5,600
400	**2,000**	113	102	56	49	90	18	20	5	3	Five	,,	2 ,,		6,600
500	**2,500**	108	97	70	60	85	18	20	5	3	Eight	,,	2 ,,		7,550
600	**3,000**	129	118	70	60	102	18	24	6	3	,,	,,	2 ,,		8,600

Write to Jarvis Engineering Company for Prices, 61 Oliver Street, Boston, Mass.

The Excelsior Combined Feed-Water Heater, Purifier, Filter, and Oil Separator.

Claims of "Percentages Saved" are tiresome and misleading; but the EXCELSIOR will beat all claims by proving on your premises that it can do these things, not only on trial but every day—

The Excelsior Combined Feed-Water Heater Purifier, Filter, and Oil Separator

Will save water and fuel more than any other heater.

Will deliver feed-water hotter than any other heater—right up to boiling point, ready to make steam the instant it reaches the boilers—and this regardless of the impurities in the water.

Will clean out of this water, without using an independent separator, practically every particle of oil, and also keep back all impurities that can be precipitated with exhaust steam.

Will help the pumps and engines it serves, both by clean, pure, and hot water, and by avoiding all back pressure.

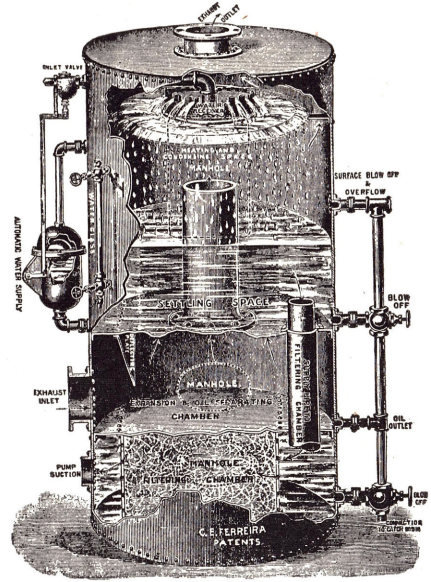
Will keep boilers in better condition than any other heater, for it delivers water free from oil, and filters out impurities which other heaters allow to pass.

Will do all this work in little space, and will do nearly double the work it is rated for, on occasion, delivering water just as hot.

Can be cleaned in less than half the time required for the simplest of competing heaters, as it contains no trays or pans to be fouled.

Has the only reliable valves and appliances for maintaining a uniform water-level under all circumstances.

All these claims we guarantee, and our heaters are placed under a contract which enables you to *send them back if claims are not fully met.* You run no risk. Write us for specifications and details.



This is Our No. 1 Style for Power Plants. No. 2 Style is Equipped with Trap for Heating System. All Heaters with Exhaust Inlets and Outlets of Ten Inches Diameter and Less have Threaded Flanges; Larger Than Ten Inches have Neck Flanges, as Shown in Cut.

Exhaust Steam for Heating Feed-Water for Boilers.

We will not go into an elaborate calculation, but will say from experience, that the exhaust steam from the average stationary engine is worth for heating feed-water, eighty-five per cent. after leaving the engine cylinder, of what it was worth when it left the boiler, or, to state it differently and arrive at the same conclusion, we would put it thus:

Steam taken from a boiler at 60 to 100 pounds and expanded in the cylinder of an engine nearly to atmospheric pressure, only loses about fifteen per cent. of its heating power. This being the case, it would be very improvident to throw this valuable agent away, after producing it at a great cost in fuel and labor.

The proper way to get the most benefit from this heat in the form of exhaust steam is to heat with it the feed-water for the boiler as near boiling point as possible. This is accomplished in a greater or less degree by many of the heaters now on the market, but very few of them bring it up to what it should be, 208 degrees to 212 degrees Fahrenheit.

Heating the feed-water means more than a saving of fuel. It means prolonging the life of the boiler, reducing the danger of explosions and loss of time from leakages and breakdowns.

Q. What is the last thing to do at night before leaving the plant?

A. Look around for greasy waste, hot coals, matches, or anything which could fire the building.

Q. How would you increase the power of an engine?

A. Increase the speed or boiler pressure.

Q. How do you find the horse-power of an engine?

A. Multiply the speed of the piston in feet per minute by the area of the piston in square inches and by the mean effective pressure in pounds per square inch, and divide the product by 33,000.

Q. How hot can you heat water under atmospheric pressure with exhaust steam?

A. 212 degrees.

Q. Does pressure have any influence on the boiling point?

A. Yes.

Q. Which do you think is the best economy, to run with your throttle wide open or partly shut?

A. Always have the throttle wide open on an automatic cut-off engine.

Q. At what temperature has iron the greatest tensile strength?

A. About 600 degrees.

Q. In what position on the shaft does the eccentric stand in relation to the crank?

A. About 90 degrees ahead of the crank.

Q. About how many pounds of water per hour are required to yield one horse-power with our best engines?

A. From 25 to 30 pounds with simple non-condensing engines, 18 to 21 pounds with simple condensing engines, and 12 to 14 pounds with compound condensing engines.

Q. What is air composed of?

A. It is composed of nitrogen and oxygen in the proportion of 77 parts of nitrogen to 23 parts of oxygen by weight.

Q. What parts of the air combine with what parts of the coal in the process of combustion?

A. The oxygen of the air combines with the carbon and hydrogen of the coal.

SCHUTTE & KOERTING COMPANY

Successors to L. SCHUTTE & CO.

12TH AND THOMPSON STREETS, PHILADELPHIA.

SOLE MANUFACTURERS UNDER PATENTS OF L. SCHUTTE AND OF E. KORTING.

UNIVERSAL INJECTORS.
UNIVERSAL STEAM SYPHONS.
UNIVERSAL INDUCTION CONDENSERS.
UNIVERSAL BLOWERS.

WATSON & MULLER STEAM TRAP.
STEAM MOTORS FOR TURN TABLES.
HYDRAULIC MACHINERY.
HIGH-CLASS GLOBE VALVES.

Automatic Valves and Appliances Made to Order.

CONTRACTORS FOR SPECIAL MACHINERY AND ORDNANCE AMMUNITION.

Represented in the New England States by the Jarvis Engineering Company, who will be pleased to quote prices and furnish additional information upon inquiry.

Universal Double Tube Injector.

The capacity of the injector should be about 30 per cent. in excess of the maximum requirement of the boiler. A boiler horse-power is the evaporation of 30 lbs. of water per hour; adding 30 per cent. to this, the required injector capacity may be stated at about 40 lbs., or 5 gals. per hour for each boiler horse-power.

By multiplying the number of boiler horse-power, for which size of injector is to be selected, by 40 or 5 it gives the total required capacity of the injector respectively, pounds or gallons. Comparing this result with table of capacities (page 36) gives the capacity in gallons, the number or size of the injector and corresponding horse-power.

For intermediate capacities select next larger size.

Where the horse-power of a boiler is not known, it may be approximated from the following data (all dimensions being in feet): —

Flue boilers, one or two flues (diam. × length ÷ 3).

Tubular boilers, upright (sq. of diam. × height ÷ 4).

Tubular boilers, horizontal (sq. of diam. × length ÷ 5).

Tubular boilers, loco. type (sq. of diam. of waist × length over all ÷ 6).

Water tube boilers (total heating surface in square feet ÷ 10).

Grate surface (area in square feet × 3).

Coal burnt per hour (number of pounds ÷ 3½).

The results from above formulas express the evaporative capacity of a boiler in horse-power based on the evaporation of 30 lbs. of water per horse-power per hour.

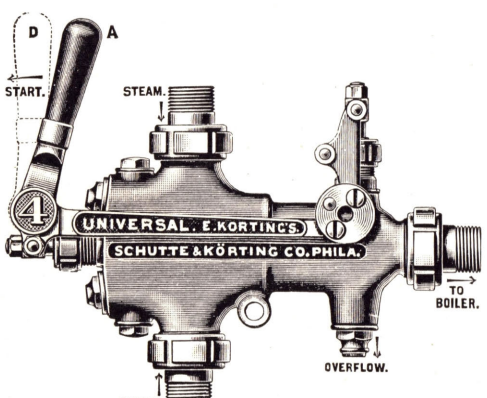
DUTY OF INJECTOR UNDER VARIOUS CONDITIONS.

Injector taking water of 80 deg. Fahr. under suction of 6 ft. with water at higher temperature, or lower temperature, or a few feet more or less lift, or with water flowing to the injector, the capacity varies more or less about 5 per cent. This, however, need not be

considered when selecting size, as there is sufficient margin if selected according to the above rules. If, however, the suction height is considerably more (say from 10 to 16 feet), then the next larger size injector should be selected. *Limit of height of suction* in all sizes from No. 1 to No. 20 lift 20 feet, but it is recommended not to exceed 16 feet if it can be avoided. The limit for No. 0 is 15 feet, and for No. 00 10 feet.

Universal Double Tube Injector.

Working to best advantage under all conditions. Take water at a temperature of 150 degrees Fahrenheit. Stop and start by one movement of a lever.



Price List and Table of Capacities.

Size No.	Price.	Size of Iron Pipe.	Steam 50 lbs.		Steam 100 lbs.		Steam 150 lbs.		Size of Copper Pipe O. D.
			Gallons.	H. P.	Gals.	H. P.	Gals.	H. P.	
00	$20	⅛	33	7	48	10	60	12	¼
0	21	¼	83	17	101	20	112	22	⅜
1	23	⅜	112	23	143	30	180	36	½
2	28	½	172	35	210	40	232	46	⅝
3	38	¾	278	56	338	70	397	80	⅞
3½			398	80	472	95	547	110	
4	50	1	533	108	622	125	720	150	1⅛
5	60	1¼	675	136	802	160	922	190	1½
6			825	165	990	200	1,125	230	
7	85	1½	1,072	215	1,372	280	1,612	320	1¾
8			1,388	280	1,800	360	2,115	430	
9	120	2 St. & D. 2 Suc. 2½	1,688	340	2,100	420	2,475	500	2¼ St.& D2¼ Suc. 2¾
10			2,025	400	2,438	500	2,850	570	
11	165		2,530	500	3,050	625	3,515	712	
12		2½	3,000	600	3,638	750	4,252	850	2¾
14	250	3	3,867	780	4,635	930	5,500	1,100	3¼
16			5,020	1,000	6,075	1,200	7,000	1,400	
20	450	4	9,000	1,800	10,840	2,200	12,525	2,500	4¼

The H. P. in above table is based on about 5 gallons per H. P., which is 30 per cent. in excess of the corresponding boiler H. P. For intermediate capacities, and also if suction exceeds 10 ft. vertical, select next larger size of injector.

Q. How much air is required to combine with the coal?

A. About 150 cubic feet or 12 lbs. of air for every pound of coal.

Q. How many pounds of air are required to burn one pound of hydrogen?

A. Thirty-six.

Q. Does hydrogen produce more heat in burning than carbon?

A. Yes, four and one quarter times as much.

Q. What part of the coal gives out the most heat?

A. The hydrogen does, part for part, but as there is so much more carbon than hydrogen in the coal, the greatest amount of heat comes from the carbon.

Q. In how many different ways is heat transmitted?

A. Three — by radiation, by conduction, and by convection.

Q. What does water consist of?

A. Oxygen and hydrogen.

Q. In what proportion?

A. Eight of oxygen to one of hydrogen by weight.

Q. What are the different kinds of heat in steam?

A. Latent heat and sensible heat.

Q. What is meant by atmospheric pressure?

A. A pressure of zero by the ordinary steam gauge.

Q. What is the pressure of the atmosphere at sea level?

A. 14.7 pounds above a perfect vacuum.

Q. What is the coal consumption per hour per indicated horse-power in different kinds of first-class engines?

A. It varies from $1\frac{1}{2}$ to 5 pounds.

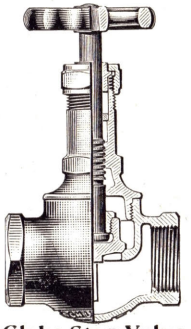
Q. What is the consumption of steam per hour per indicated horse-power?

A. From 12 to 50 pounds.

Q. How many pounds of water can be evaporated with one pound of best soft coal, assuming a feed-water temperature of 212 degrees.

A. About 11 pounds in the best boilers.

Extra Heavy Hard Bronze Valves.



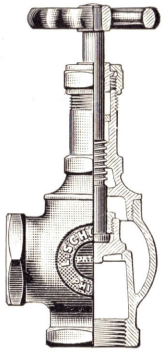
Globe Stop Valve.

ALL METAL.

For Pressure up to 250 Pounds.

Made of new metal only (copper and tin) and guaranteed steam tight.

We also make **Globe Stop Valves and Angle Stop Valves** with renewable hard rubber or leather disc when ordered, at same price.

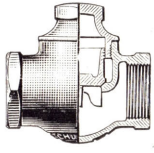


Angle Stop Valve.

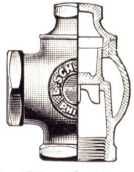
Globe and Angle Check Valves.

(With Patent Noiseless Piston.)

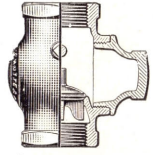
ALSO VERTICAL CHECK VALVES.



Globe Check Valve.

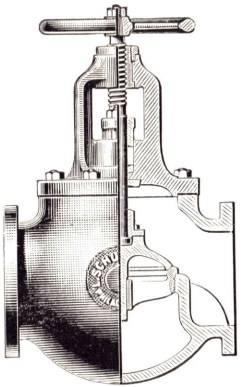


Angle Check Valve.



Vertical Check Valve.

Extra Heavy Flanged, Iron Body, Bronze Mounted, Valves.



Globe Stop Valve.

For Pressures up to 250 Pounds

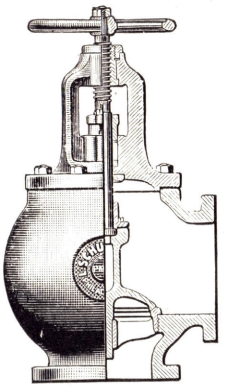
GUARANTEED STEAM TIGHT.

All bronze in these valves is the same as in valves listed on previous pages, viz., a mixture of pure copper and tin, and new metal only is used.

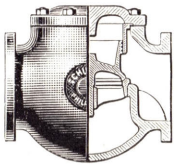
Globe and Angle Check Valves.

(With Patent Noiseless Piston.)

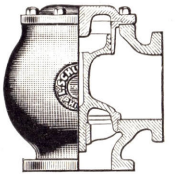
Also Vertical Check Valves.



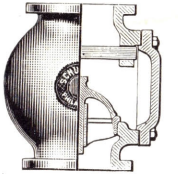
Angle Stop Valve.



Globe Check Valve.



Angle Check Valve.



Vertical Check Valve.

S E N D F O R P R I C E L I S T .

Q. How much steam will one cubic inch of water produce under atmospheric pressure?

A. One cubic foot of steam (approximately).

Q. What is the weight of a cubic foot of fresh water at 60 degrees?

A. About 62½ pounds.

Q. What is the weight of a cubic foot of cast iron?

A. About 450 pounds.

Q. What is the weight of a square foot of one-half inch boiler plate?

A. About 20 pounds.

Q. How much wood equals one ton (2,000 pounds) of soft coal for steam purposes?

A. About 5,000 pounds of wood?

Q. Of what does coal consist?

A. Carbon, hydrogen, nitrogen, sulphur, oxygen, and ash.

Q. What are the relative proportions of these that enter into coal?

A. There are different proportions in different specimens of coal, but the following shows the best results from semi-bituminous coal: carbon 85, hydrogen 4, nitrogen 1, sulphur 1, oxygen 4, ash 5.

Q. How do you calculate the horse-power of horizontal tubular boilers?

A. Measure the heating surface and divide the area by twelve.

Q. What do you understand by "lead" on an engine valve?

A. "Lead" refers to the admission of steam into the cylinder before the piston completes its previous stroke.

Q. What is the clearance of an engine as the term is applied at the present time?

A. Clearance is the space between the cylinder head and the piston head with the ports included.

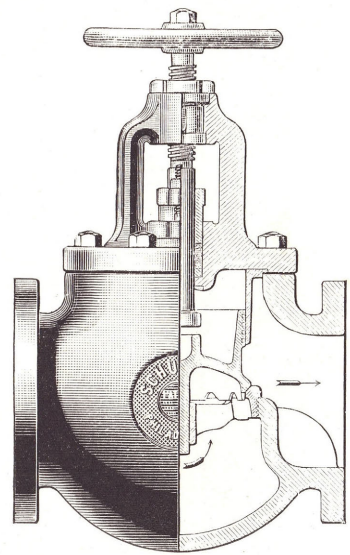
Q. What is meant by a triple expansion engine?

A. A triple expansion engine has three cylinders arranged so that the steam passes successively through all three.

The Schutte Noiseless Stop Check Valve.

For Pressures up to 250 Pounds.

GUARANTEED STEAM TIGHT.



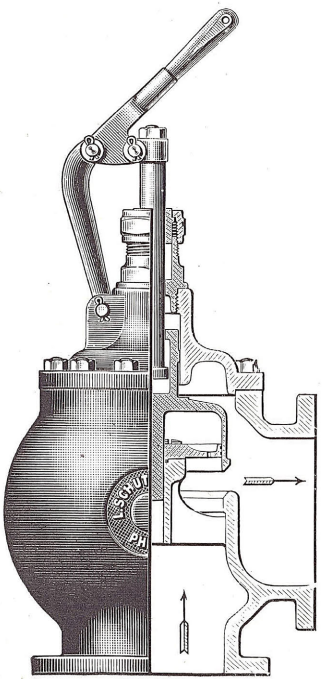
Extra Heavy Flanged Iron Body, Bronze Mounted. With Patent Noiseless Piston.

All bronze in these valves is the same as listed on previous pages, viz., a mixture of pure copper and tin, and new metal only is used.

This valve is made in *two* forms: the Globe as illustrated above, and the Angle form with bottom inlet and side outlet.

The Automatic Free Exhaust Valve.

(With Patent Noiseless Piston.)



This valve is made in three forms, as shown below; *i. e.:*

Angle
Free Exh. V.

Globe
Free Exh. V.

Down. Disch.
Free Exh. V.

The flow of exhaust when discharging into the atmosphere must be in the direction of arrows, *i. e.*, from under the valve.

SEND FOR PRICE LIST.

Steam-Jet Pumps.

For purposes where durability, small cost, simplicity of manipulation is of primary importance, or where an increase of temperature is beneficial, the Steam-Jet Pump is the most desirable appliance for moving water or other liquids.

Desirable applications are for **Bilge or Wrecking Pumps**; **Tank Pumps** for factories and railroads, or for construction locomotives; **Drain Pumps** for foundations and wells, and to clear **Cesspools**; **Acid Pumps** in factories, and to discharge tank cars.

The **Steam-Jet Pumps** listed in this book we call

UNIVERSAL SYPHONS,

and they have been constructed with the view of greatest convenience for attachment; they have two steam inlets, and two discharge outlets, either of which may be used, and the other closed by a plug.

The proportions of steam pressure and height of elevation to which our standard machines are constructed are as follows:

Steam pressure in pounds	20	40	60	80	100
Total elevation in feet	20	40	60	80	100

The apparatus is best suspended a few feet above the liquid, but it may be immersed under water, or suspended above at a greater height, within the *limit of suction*, which is as follows :

Steam pressure in pounds	20	40	60	80	100
Limit of suction in feet. Steam full on	18	18	15	12	9
Limit of suction in feet. Steam regulated	18	20	24	24	24

Where the total elevation is not great, we make syphons special for twenty-four feet suction, and steam turned on full. Where syphon can be placed under water, or where water flows to it, we make them special, to overcome a total elevation double that given above.

The approximate weight of steam used and temperature increase is:

Elevation in feet	20	40	60	80	100
Increase in temperature. Degree Fahrenheit	15	20	24	28	32
Proportion of steam to water discharge	1-84	1-65	1-58	1-48	1-42

Where it is necessary to have syphons overcome a proportional higher elevation, and at the same time maintain suction, or where automatic attachment is required, we make syphons special to suit all conditions within limits, and at special prices.

Universal Syphon.

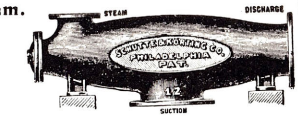
Sizes from ½ to 3 Inches, Screwed Ends.

Steam. Discharge.

Suction.

Sizes from 4 to 12 Inches, Flanged Ends.

Steam. Discharge.



Suction.

The capacities as given in annexed table are with 60 pounds steam, 30 feet elevation, and syphon placed near water-level.

Price List and Table of Capacities.

Size. Inches.	Price. Brass.	Price. Iron.	Price. Suction.	Diameter of Pipes. Discharge.	Diameter of Pipes. Steam.	Capacity. Gallons per hour.
½	**$4**	$3	½	½	¼	200
¾	**6**	5	¾	¾	⅜	400
1	**8**	7	1	1	½	700
1¼	**12**	10	1¼	1¼	¾	1,100
1½	**16**	13	1½	1½	¾	1,600
2	**24**	17	2	2	1	3,000
2½	**36**	25	2½	2½	1¼	5,000
3	**56**	40	3	3	1½	8,000
4	**100**	70	4	3½	2	15,000
6	**220**	150	6	5	2½	30,000
8	**380**	250	8	6	3	60,000
10	**600**	400	10	8	4	90,000
12	**860**	600	12	10	5	150,000

When ordering, state :—

1. Quantity, Nature, and Temperature of the liquid.
2. Total height between levels.
3. Height of suction.
4. Minimum Steam Pressure.
5. If strainer is required.

STRAINERS.

Price List.

Size.	½	¾	1	1¼	1½	2	2½	3	4	6	8	10	12
Brass.	**$1.00**	**$1.50**	**$2.00**	**$3.00**	**$4.00**	**$6.00**	**$9.00**	**$14.00**	**$25.00**	**$40.00**	**$70.00**	**$110.00**	**$170.00**
Iron.	0.90	1.40	1.90	2.50	3.50	5.00	7.00	10.00	15.00	20.00	35.00	55.00	85.00

Q. What is a condenser as applied to an engine?

A. The condenser is a receptacle into which the exhaust discharges, and by its means the steam is condensed, and a vacuum produced.

Q. About how much saving in steam is produced by using the condenser?

A. 20 to 30 per cent.

Q. How many inches of vacuum give the best results in a condensing engine?

A. 25 to 28 inches.

Q. What is meant by latent heat?

A. Heat that does not affect the thermometer, and which expends itself in changing the nature of a body, such as turning ice into water, or water into steam.

Q. How can latent heat be recovered?

A. By bringing the body back to its original state, as by condensing steam.

Q. What is meant by a thermal unit?

A. The heat necessary to raise one pound of water at 39 degrees, 1 degree Fahr.

Q. What are the properties which make steam so valuable to us?

A. 1. The ease with which it can be generated and condensed. 2. Its great expansive power. 3. The small space which it occupies when condensed.

Q. How is a vacuum maintained in a condensing engine?

A. By the steam being constantly condensed, and the air pump constantly removing the air and water.

Q. What do you understand by the term "horse-power," as applied to engines.

A. A horse-power is the work done equivalent to raising 33,000 pounds 1 foot per minute, or 550 pounds raised 1 foot per second.

Q. What do you understand by "lap" in a slide valve?

A. Outside lap is that portion of the two ends of the valve which extends beyond the ports when the valve is placed on the center of travel, and inside lap is that portion which projects over the ports on the inside or towards the middle of the valve.

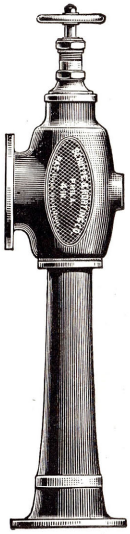
Q. What is the use of lap?

A. It controls the admission, exhaust, and compression.

Q. Where is the dead center of an engine?

A. The point where the crank and the piston are in the same right line.

Exhausters and Compressors.

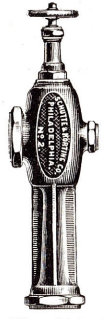


Sizes 4 to 8 ins. Flanged.

These apparatus involve the same principles of construction as the blowers and ventilators described in special catalogue; but they differ from them in that they are proportioned to overcome extreme rarefaction and counterpressure.

Comparing the table of capacities and prices with that of pumps for same purposes, it will be seen that their applicability and cost are beyond comparison: The economic consumption of steam is also in their favor.

The admissible vacuum and counterpressure to which these machines are constructed is the rarefaction up to 20 inches of mercury and above, or a counterpressure up to 1-7th of the steam pressure.



Size ¼ to 3 ins. Screwed.

Price List and Table of Capacities.

Size. Diam. of Air Pipe in Inches.	Price.	Capacity per Hour in Cubic Feet.	Diam. of Steam Pipe.	Form and Size No. corresponding to former old catalogue.
¼	$10	100	⅛	
½	15	300	¼	
¾	20	600	⅜	
1	25	1,000	⅜	000
1½	30	2,000	½	00
2	40	4,000	¾	0
2½	50	6,000	1	1
3	70	12,000	1¼	2
4	90	18,000	1½	3
5	125	27,000	2	4
6	160	35,000	2	6
7	200	48,000	2½	8
8	250	60,000	3	10

The apparatus can be placed in any position, vertical or horizontal, discharging upwards or downwards, or horizontal.

Traps must be avoided both in suction and discharge pipes; a trap filled with liquid will destroy or greatly impair the efficiency of the apparatus.

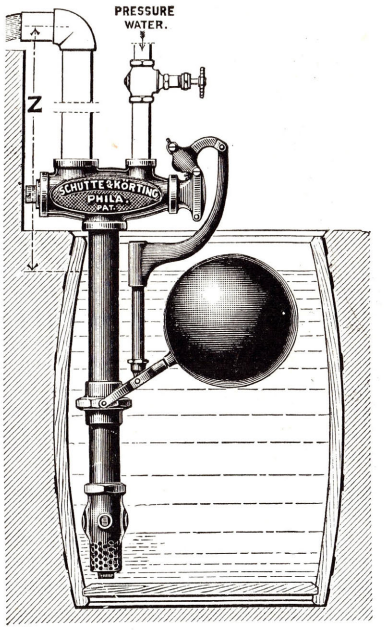
When the apparatus is applied as an agitator, or otherwise discharging under liquids, it is best to arrange the distributing pipes about 20 inches apart. The perforations of the distributing pipes must be at bottom and under an angle, – their combined area double the area of the pipe, and diameter of holes not to exceed ⅜ inch.

The pressure in pounds per square inch at the eductor (when running) should, if possible, be not less than 2½ times the elevation in feet. Per example: For an elevation of 10 ft. it is desirable to have 25 pounds pressure.

The eductor will take water of any temperature up to boiling.

The eductor has a strong suction even with low pressure. Where elevation does not exceed 15 ft. it can be placed at discharge level; but discharge pipe must have an upward turn, as shown in cut, or the eductor may be placed lower down, and fitted with discharge leading upwards.

When accumulated water has to be removed at intervals, or certain seasons of year only, the plain eductor answers the purpose, but for continuous working the automatic eductor listed below should be used.



The Automatic Universal Water-Jet Eductor.

Price List and Table of Capacities.

Size. Inches.	Price. Complete.	Size of Pipes.		Capacity. Gallons per Hour.
		Suction and Discharge.	Pressure.	
¾	$30.00	¾	⅜	250
1	35.00	1	½	500
1¼	45.00	1¼	¾	700
1½	55.00	1½	¾	1,000
2	70.00	2	1	2,000
2½	100.00	2½	1¼	3,000

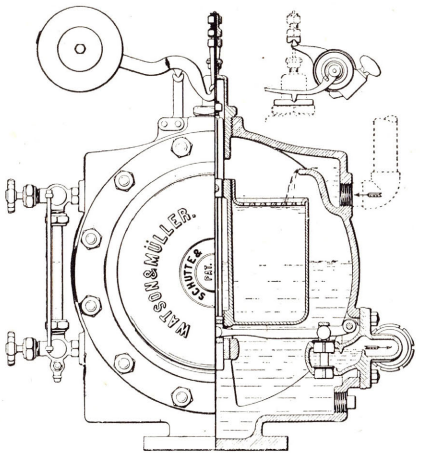
Larger sizes on application.

The appliance as illustrated here is complete and automatic. When pit is filled it turns on the pressure water full, and it remains turned on till pit is empty, when water shuts off till pit is full again.

A barrel will take in any size eductor listed here.

A half barrel will take in ¾ and 1-inch size.

Watson & Müller Steam Trap.



For marine purposes the lever and weight is substituted by this spring balance.

The thumbscrew regulates the tension and therewith the water-level in trap.

When ordering: please specify lever and weight for **stationary**; spring balance for **marine purposes.**

Table of Capacity.

Discharge of Condensed Water in Gal. per Hour.

Size.	Pounds Pressure per Square Inch in Heating Pipes.					
Inches.	1	5	10	20	40	60
¾	350	900	1,200	1,500	1,800	2,100
1	720	1,800	2,400	3,000	3,600	4,200
1½	1,600	4,000	5,200	6,750	8,000	9,200
2	2,800	7,000	9,000	12,000	14,000	16,000

The discharge valve is balanced. The float is a tank full of water, and balance outside.

The displacement of water outside causes the tank to rise or fall, and regulates valve for continuous discharge. The connection between tank and balance is through a wire attached to the guide stem by a clamp-nut.

The packing around wire **is not a stuffing box,** but contains a thread of wool for the purpose of preventing whistling when air escapes.

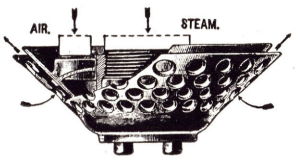
This nut should never be tightened.

The removal of the guide-box on top exposes the clamping nut which secures wire, and it can then be adjusted.

The discharge valve, complete with lever, can be removed for examination, by taking off nuts and uncoupling union on outlet.

Water-Heating by Direct Steam.

THE NOISELESS HEATER.



The disturbing noise and destructive effect on open tanks, when steam is introduced into the water through perforated pipes, is entirely obviated by attaching the **Noiseless Heater** to the end of the steam pipe.

The heater discharges in the form of an inverted cone, offering a large surface and thus causing rapid condensation.

If water is to be heated to a temperature not exceeding 165 degrees Fahrenheit, the air inlet on heater is closed with a plug and nothing but the heater is needed, as it will be noiseless with any pressure of steam, from 5 pounds to 100 pounds and above.

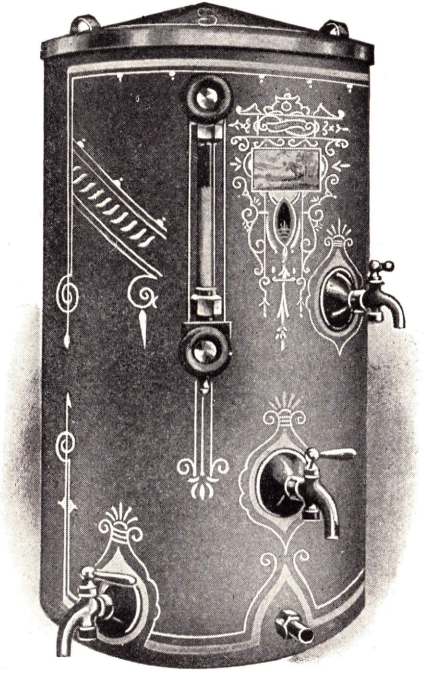
If water is to be heated to a temperature above 165 degrees and up to boiling point, then an air pipe must be attached. The purpose of this pipe is to permit air to be supplied in the discharge jet, and by its admixture, prevent the formation of steam bubbles, which otherwise, in rising to the surface, escape and collapse and thus cause the noise. Thus water is heated in less time and with less expenditure of steam than could be done by the use of a perforated pipe. The air is drawn in through the action of the heater if steam pressure is proportionate to the depth of the water in the tank above the apparatus, viz.:

Height of water above heater, or depth of tank in feet . . .	3	4	5	6	7	8
Minimum steam pressure in pounds	4	8	12	18	24	32

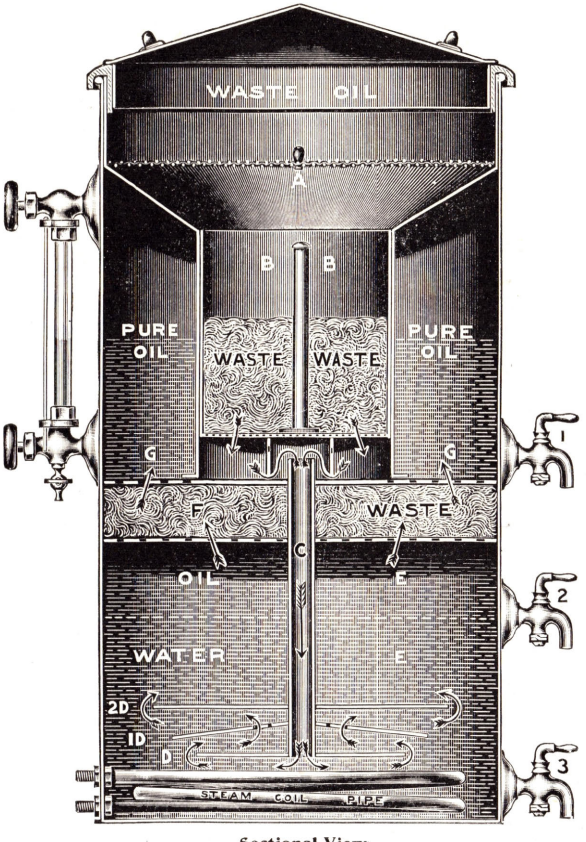
Thus under the above conditions the heater will work noiseless up to any temperature by the addition of the air pipe, which had best be fitted with a cock or valve.

Saving Waste Oil.

Every user of lubricating oil appreciates the fact that the larger portion of all the oil he buys is not consumed by the machinery on which it is used, but passes through, and, but for the fact that it becomes filled with dirt and grit, could be used again. Because of the dirt and grit in it, however, it is thrown away as waste oil. This waste frequently amounts to from 50 to 75 per cent. of the oil used; thus $50 to $75 of every $100 invested in oil is thrown away. The lubricating properties are not affected in the least, and if the impurities can be eleminated the oil can be used over and over again with perfect safety. With a Cross Oil Filter at hand, oil may be used over and over again. There is no waste, and every dollar's worth of oil is used up.



The Cross " Regular."



Sectional View.

Data and Memoranda.

A cubic inch of cast iron weighs .26 lbs.; tin, .265 lbs.; wrought iron, .278 lbs.; brass, .31 lbs.; copper, .32 lbs.; and lead, .41 lbs.

A hundred weight (written cwt.) is 112 lbs.

A hand is equal to 4 inches.

A span is equal to 9 inches.

A meter is equal to 39⅜ inches.

A fathom is equal to 6 feet.

A circle in circumference is about $3\frac{1}{7}$ times its diameter, and in area .785 of the square of the diameter.

One acre is equal to 43,560 square feet, or 160 square rods.

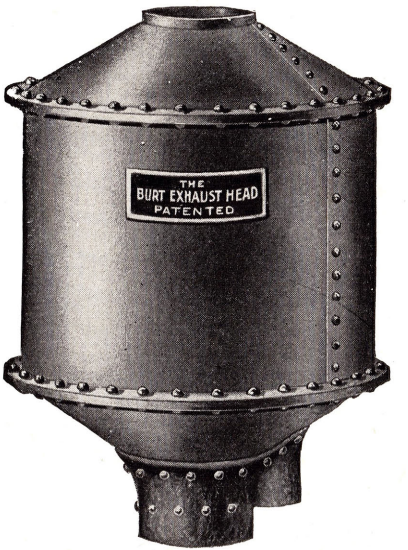
One mile in length is equal to 5,280 feet, or 320 rods.

A nautical mile is equal to 1 knot, or 6,080 feet, or 1,014 fathoms.

Patterns made of best white pine lumber, without nails or screws, are about $\frac{1}{16}$ the weight of iron or steel, and $\frac{1}{18}$ of composition castings.

Weight of a superficial foot of plate iron, $\frac{1}{16}$ inch to 1 inch thick.

Inch.	Pounds.	Inch.	Pounds.
1	40	⅜	15
⅞	35	¼	10
¾	30	⅛	5
⅝	25	$\frac{1}{16}$	2.5
½	20		



The specific gravity of steam (at atmospheric pressure) is .411 that of air at 34 degrees Fahr., and .0006 that of water at same temperature; 26.36 cubic feet of steam at atmospheric pressure weigh 1 pound; 13.14 cubic feet of air at 62 degrees weigh one pound.

Temperatures corresponding to various degrees of vacuum in condenser.

0	inches,	Vacuum.	212	27½	inches,	Vacuum.	212
11	"	"	190	28½	"	"	92
18	"	"	170	29	"	"	72
22½	"	"	150	29½	"	"	52
25	"	"	135				

SEND FOR PRICE LIST.

WE ARE AGENTS IN THE STATES

OF MAINE, NEW HAMPSHIRE, VERMONT, MASSACHUSETTS, RHODE ISLAND, AND CONNECTICUT FOR THE

MORSE-BOULGER DESTRUCTOR COMPANY.

INCORPORATED UNDER THE LAWS OF THE STATE OF NEW YORK.

Under the patents owned or controlled by this company we deal with the entire field of *Garbage and Refuse Utilization, Treatment, and Disposal*, and guarantee durability of material and workmanship, efficiency, and economy in operation, and strict compliance with sanitary laws. We will supply

DESTRUCTORS

for the disposal of *Municipal Garbage and Refuse, Street Sweepings, Dead Animals, and Night-Soil*, and all other classes of waste matter, by methods SANITARY, EFFICIENT, ECONOMICAL.

These destructors, if desired, may provide for the production of STEAM POWER FROM WASTE for public or private use.

FOR PUMPING WATER, OR SEWAGE, ELECTRIC LIGHTING, STEAM DISINFECTION STATIONS, ETC.

We will make surveys on request, and submit estimates for the installation of

INSTITUTIONAL DESTRUCTORS

of smaller size, for Hospitals, Hotels, Public or Private Institutions, Department Stores, Factories, and all other Business Establishments.

The Construction of Plants for the

UTILIZATION OF MUNICIPAL REFUSE

Similar to those built under these patents in Boston in 1898–91 in successful operation for *six years*.

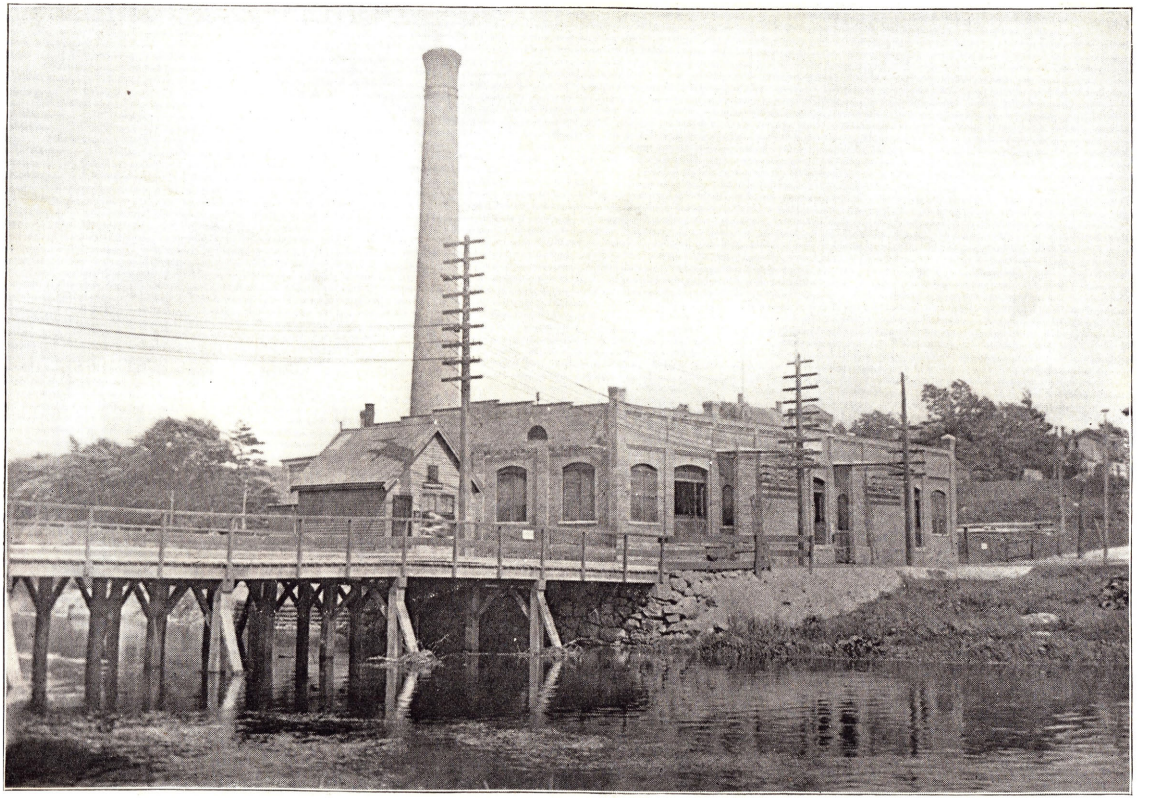
Masonry.

Masonry has always been an important branch of our business, and it is our intention to continue this branch in a high state of efficiency. The importance of good masonry in connection with the steam plant cannot be over-estimated. While excellent plans are furnished by some of the insurance companies for the setting of boilers, too often the work is left in the hands of some mason without experience to guide him in the work to be performed, and the result is that a poor job is done. We are prepared at all times to furnish material and experienced men to repair boiler furnaces and other jobbing work at a reasonable commission above the cost, and will be pleased to submit estimates for the setting of boilers, engine foundations, brick stacks, etc.

We have constantly in our employ a corps of practical masons whom we employ direct, and from whom we demand a full day's work, whether the work be done on a commission basis or otherwise. We have all necessary tools and appliances for properly conducting this class of work, and we particularly desire to call our customer's attention to this branch of our business, as we cheerfully furnish estimates on all kinds of mason work in connection with power or manufacturing plants, including new buildings.

We illustrate a few of the structures that we have recently erected, believing that the variety will be sufficient to convey to the public an idea of the kind of work we are prepared to build.

Army Hospital.



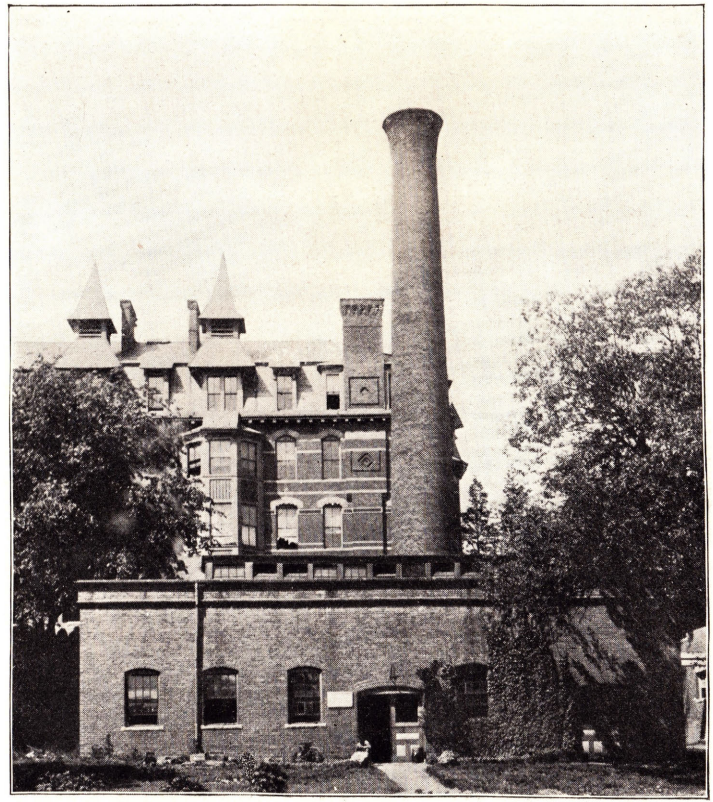
Power Station.

Foundry and Machine Shop.
(*Side View.*)

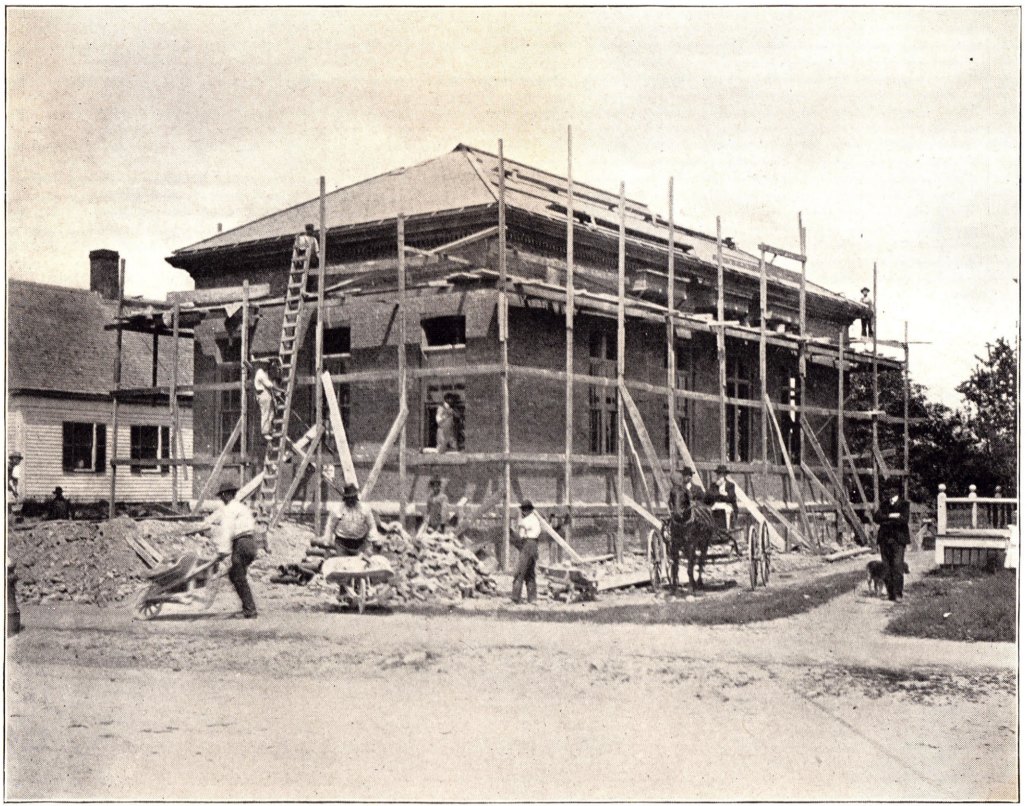
Foundry and Machine Shop.
(*Front View.*)

Foundry and Machine Shop.
(*Interior.*)

ENGINEER'S OSTRUP ENGINEERING COMPANY.



Heating and Lighting Station for Institution.



Sub-Station.

The Barta Press
BOSTON